APPENDIX A

FOUNDATIONS AND CIVIL ENGINEERING DESIGN CRITERIA

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A.1 INTRODUCTION

The design, engineering, procurement, and construction activities on the project will be in accordance with various predetermined standards and project-specific practices. This appendix summarizes the civil engineering codes and standards, design criteria, and practices that will be used during design and construction. These criteria form the basis of the design for the foundations and civil systems of the project. More specific design information will be developed during the detailed design phase to support equipment procurement and construction specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section A.2 summarizes the applicable codes and standards and Section A.3 includes the general criteria for foundations, design loads, and site work.

A.2 DESIGN CODES AND STANDARDS

A.2.1 General Requirements

The design and specification of work will be in accordance with all applicable laws and regulations of the federal government, the State of California, and the applicable local codes and ordinances. Except where noted otherwise, the latest issue of all codes and standards, including addenda, in effect at the start of the project will be used. The codes and standards, including all addenda, in effect at the time of purchase will be utilized for material and equipment procurement.

A summary of the codes and the standards to be used in the design and construction follows:

- Seismic standards and criteria will follow the California Building Code (CBC).

- Specifications for materials will follow the standard specifications of the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI), unless noted otherwise.

- Field and laboratory testing procedures for materials will follow ASTM standards.

- Design and placement of structural concrete and reinforcing steel will be in accordance with the codes, guides, and standards of the American Concrete Institute (ACI) and the Concrete Reinforcing Steel Institute (CRSI).

- Specifications for materials for roads will follow the State of California Department of Transportation Standard Specifications.

- Design and construction of roads will follow the American Association of State Highway and Transportation Officials (AASHTO) and the State of California Department of Transportation standards.

- Design and construction of the sanitary sewer system will conform to the Uniform Plumbing Code (UPC).

- Design and construction will conform to the federal and California Occupational Safety and Health Administration (OSHA and CAL-OSHA) requirements.

Other recognized standards will be used where required to serve as guidelines for the design, fabrication, and construction. Where no other code or standard governs, the California Building Code, as amended by the Los Angeles County Code, will govern.

A.2.2 Government Rules and Regulations

The following laws, ordinances, codes, and standards are applicable to the civil engineering design and construction. In cases where conflicts between cited codes (or standards) exist, the requirements of the more stringent code will govern.

A.2.2.1 Federal

- Title 29, Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards

- Title 29, CFR, Part 1926, National Safety and Health regulations for construction

- Walsh-Healy Public Contracts Act (Public Law [PL] 50-204.10)

- National Pollutant Discharge Elimination System (NPDES) (U.S. Environmental Protection Agency [EPA])

A.2.2.2 State

- Business and Professions Code Section 6704, et seq.; Sections 6730 and 6736. Requires State registration to practice as a Civil Engineer or Structural Engineer in California.

- Labor Code Section 6500, et seq. Requires a permit for construction of trenches or excavations 5 feet or deeper into which personnel have to descend. This also applies to construction or demolition of any building, structure, false work, or scaffolding that is more than three stories high or equivalent.

- Title 24, California Code of Regulations (CCR) Section 2-111, et seq.; Section 3-100, et seq.; Section 4-106, et seq.; Section 5-102, et seq.; Section 6-T8-769, et seq.; Section 6-T8-3233, et seq.; Section 6-T8-3270, et seq.; Section 6-T8-5138, et seq.; Section 6-T8-5465, et seq.; Section 6-T8-5531, et seq.; and Section 6-T8-5545, et seq. Adopts current edition of CBC as minimum legal building standards.

- State of California Department of Transportation, Standard Specifications.

- Title 8, CCR Section 1500, et seq.; Section 2300, et seq.; and Section 3200, et seq. Describes general construction safety orders, industrial safety orders, and work safety requirements and procedures.

- Regulations of the following State agencies as applicable:

  - Department of Labor and Industry Regulations
  - Bureau of Fire Protection
  - Department of Public Health
  - Water and Power Resources.

- Vehicle Code, Section 35780 et seq. Requires a permit from Caltrans to transport heavy loads on state roads.

A.2.2.3 Local

- Los Angeles County Building Code

- Los Angeles Flood Control District Code

A.2.3 Industry Codes and Standards

A.2.3.1 American Association of State Highway and Transportation Officials (AASHTO)

- A Policy on Geometric Design of Highways and Streets.

A.2.3.2 American Concrete Institute (ACI)

ACI 117	Standard Specification for Tolerances for Concrete Construction and Materials
ACI 211.1	Standard Practice for Selecting Proportions of Normal, Heavyweight, and Mass Concrete
ACI 301	Specifications for Structural Concrete for Buildings
ACI 302.1R	Guide for Concrete Floor and Slab Construction
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308	Standard Practice for Curing Concrete
ACI 309R	Guide for Consolidation of Concrete
ACI 311.4R	Guide for Concrete Inspection
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 318.1	Building Code Requirements for Structural Plain Concrete
ACI 347R	Guide to Formwork for Concrete

A.2.3.3 American Society for Testing and Materials (ASTM)

ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A116	Standard Specification for Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A121	Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C289	Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C443	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C586	Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method)
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C1064	Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))

ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D2216 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock

ASTM D2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D3017 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM D3740 Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM E329 Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

A.2.3.4 Concrete Reinforcing Steel Institute (CRSI)

Manual of Standard Practice.

A.2.3.5 International Association of Plumbing and Mechanical Officials

UPC Uniform Plumbing Code.

A.2.3.6 International Conference of Building Officials

CBC California Building Code.

A.3 CIVIL DESIGN CRITERIA

A.3.1 Foundations

A.3.1.1 General

Geotechnical exploration, testing, and analysis determine the most suitable bearing methods for foundations. Criteria will be established to permit design of the most economical foundation that is compatible with the life expectancy and service of the structure.

The results of earlier subsurface investigations and geotechnical assessments for the existing site are presented in Appendix G, Geotechnical Engineering Investigation. These results indicate that the existing subgrade will provide adequate allowable bearing pressures to allow the use of shallow foundations for all plant structures.

A.3.1.2 Foundation Design Criteria

Allowable settlements for all foundations (based on predicted elastic or short-term, and consolidation or long-term settlements) will be limited as follows:

- Total settlement: 1.5 inch
- Differential settlement: 0.1 percent between adjacent foundations.

Foundations for all critical structure and equipment will be supported on reinforced concrete mat foundations bearing directly on undisturbed soil or compacted fill. Noncritical or lightly loaded structures and equipment will be founded on individual spread footings. The design of reinforced concrete foundations will satisfy the requirements of ACI 318.

Spread footings will have a minimum width of 3 feet, and a minimum width of 2 feet will be provided for wall footings. The bottom of footings will be located a minimum of 12 inches below finished grade.

Detailed foundation design criteria, including allowable bearing pressures, will be developed based on the results of additional subsurface investigations performed during the detailed design phase of the project. Allowable bearing pressures will include a safety factor of at least 3 against bearing failures.

A.3.1.3 Equipment Foundations

Each piece of equipment will be supplied with a reinforced concrete foundation suitable to its operation. Where the equipment could induce excessive vibration, the foundation will be provided with adequate mass to dampen vibratory motions. Special consideration will be

given to vibration and stiffness criteria where specified by an equipment manufacturer. Equipment located within an enclosed building with a grade slab will generally be placed on a concrete pad that is raised above the grade slab to keep the equipment off the floor surface.

Minimum temperature and shrinkage reinforcing steel will be provided for equipment foundations unless additional reinforcement is required for the equipment loads. Anchor bolts designed to develop their yield strength will be provided for critical equipment. For noncritical or lightly loaded equipment, concrete expansion anchors may be utilized to secure equipment to foundations.

A.3.1.4 Rotating Equipment Foundations

Dynamic behavior will be considered in the design of foundations subjected to significant rotating equipment loads such as foundations for the combustion turbines, steam turbines, and the boiler feedwater pumps. A dynamic analysis will be performed to determine the natural frequencies and dynamic responses of the foundation. To account for soil and structure interaction, geotechnical data will be used to determine the soil stiffnesses and damping coefficients used in the dynamic analysis.

Dynamic responses will satisfy the equipment manufacturer's criteria and/or industry standards in terms of maximum velocity/displacement amplitudes that are considered acceptable for machine and human tolerances. To avoid resonance during machine operation, the resonant frequency of the foundation will typically be less than 80 percent or greater than 120 percent of the machine operating speed.

A.3.2 Design Loads

A.3.2.1 General

Design loads for structures and equipment foundations are discussed in Appendix B. Design loads for pavements and buried items will be determined according to the criteria described below, unless the applicable building code requires more severe design conditions.

A.3.2.2 Wheel Loads

Loads exerted on roadway pavements, buried piping, electrical duct banks, and culverts will be reviewed and selected prior to design of the underlying items. As a minimum, these items will be designed for HS20-44 loadings in accordance with AASHTO Standard Specifications. Loadings exceeding the HS20-44 loadings will be considered where found applicable during the detailed design phase.

A surcharge load of 250 psf will be applied to plant structures accessible to truck traffic.

A.3.3 Site

A.3.3.1 Site Arrangement

The site arrangement will conform to all applicable laws, regulations, and environmental standards. The principal elements to be considered in selection of the site arrangement are the physical space requirements and relationships dictated by each of the major plant systems, and the constraints imposed by the physical size and existing topography of the site. Distances from the main plant to various systems will be minimized for economy. However, adequate clearance between various plant systems will be provided as needed for construction, operations, maintenance, and fire protection. The plant will be configured to minimize construction costs and visual impacts while remaining operationally effective. Utility interconnections will be optimized.

A.3.3.2 Site Preparation

Site preparation will consist of clearing and grubbing, the excavation of soils to design grade, and the preparation of fill slopes and embankments designed in such a fashion as to be stable and capable of carrying anticipated loads from equipment or structures.

Root mats, if any, will be removed to a depth of not less than 2 feet below existing grade, and holes will be refilled with material suitable for embankment and compacted. Materials from clearing and grubbing operations will either be removed from the site or, if suitable, reused on site.

A.3.3.3 Earthwork

Based on the results of previous subsurface investigations as discussed in Appendix G, generally dense sands of the Old Dune and Gage sands are encountered throughout the site. Soils below final site grade will consist of controlled compacted fill and natural, dense, sand soils.

Shallow foundations built on controlled compacted fill and the Old Dune and Gage sand soils are expected to undergo total settlements of less than 1.5 inch and differential settlement between neighboring foundations of less than 0.1 percent.

The depth of the controlled, compacted fill placed after demolition work is anticipated to be 5 to 20 feet.

Excavation. Excavation work will consist of the removal, storage, and/or disposal of earth, sand, gravel, vegetation, organic matter, loose rock, boulders, and debris to the lines and grades necessary for construction.

Materials suitable for backfill will be stored in stockpiles at designated locations using proper erosion protection methods. Other excess noncontaminated material will be removed from the site and disposed of at an acceptable location. Disposal of contaminated material if encountered during excavation will comply with all applicable federal, state, and local regulations.

Confined temporary excavations will be sloped or braced to prevent cave-ins during construction. All excavation and trenching operations will comply with local, state, and federal OSHA regulations.

Based on previous subsurface investigations, the groundwater was typically encountered at 12 feet below ground surface. This would correspond to an approximate elevation of 8.0 MLLW which is below the bottom of the deepest structural excavation. Dewatering and disposal of groundwater for structural excavations is anticipated, as discussed in Section 5.14, Waste Management.

Grading and Embankments. Graded areas will be smooth, compacted, free from irregular surface changes, and sloped to drain to the site drainage system.

Final earth grade adjacent to buildings will be at least 6 inches below finished floor slab and will be sloped away from the building to maintain proper drainage.

Cut and fill slopes for permanent embankments will be designed to withstand the appropriate design level ground motion. This will likely result in flat slopes. Geogrid reinforcement for fill slopes and soil nailing for cut slopes may be used for steep slopes requiring soil reinforcement to resist seismic loading. Slopes for embankments will be no steeper than 2:1 (horizontal:vertical). Construction will be at the existing plant grade which is fairly level so major cuts or fills are not anticipated.

Backfilling and Compaction. Areas to be backfilled will be prepared by removing unsuitable material and rocks. The bottom of an excavation will be examined for loose or soft areas. Such areas will be excavated fully and backfilled with compacted fill.

Backfilling will be done in layers of uniform, specified thickness. Soil in each layer will be properly moistened to facilitate compaction to achieve the specified density. In order to verify compaction, representative field density and moisture-content tests will be taken during compaction.

Structural fill supporting foundations, roads, parking areas, etc., will be compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. Embankments, dikes, bedding for buried piping, and backfill surrounding structures will be compacted to a minimum of 90 percent of the maximum dry density. General backfill placed in remote and/or unsurfaced areas will be compacted to at least 85 percent of the maximum dry density.

Where fills are to be placed on subgrades sloped at 6:1 (horizontal:vertical) or greater, keys into the existing subgrade may be provided to help withstand horizontal seismic ground accelerations.

The subgrade (original ground), subbases, and base courses of roads will be prepared and compacted in accordance with California Department of Transportation (Caltrans) requirements. Testing will be in accordance with ASTM and Caltrans standards.

A.3.3.4 Site Drainage

The site drainage system will be designed to comply with all applicable federal, state, and local regulations.

The existing drainage on north end of the site consists of paved areas sloped to drop inlets with the stormwater routed through a system of gravity flow storm drain pipes and then discharged to the ocean through existing Discharge No. 001. The new power block area will utilize the same type of drainage system.

The existing drainage at the fuel oil tank area consists of stormwater collection within the containment berm and periodic pump outs as required after a storm event. The revised drainage within the tank area will consist of grading to new drop inlets with the stormwater routed through storm drain pipes and then discharged to the ocean through the existing Unit 3 and 4 discharge structure.

The existing drainage at the new Administration/Maintenance Building area consists of a system of drop inlets and storm drain pipes which route the stormwater to the ocean through the existing Unit 3 and 4 discharge structure. The new administration/maintenance area will utilize the same type of drainage system.

The ground floor elevation of structures will be maintained at a minimum of 6 inches above the finished grade. The graded areas away from structures will be at a minimum slope of 1 percent.

Design of the site drainage facilities will be performed in accordance with the Los Angeles Flood Control District Hydraulic Design Manual and the Los Angeles County Public Works Hydrology/Sedimentation Manual. Drainage facilities will be designed for the flow resulting

from a 10-year, 24-hour rainfall. They will also be designed to prevent flooding of permanent plant facilities and overflow of plant roads during a 25-year, 24-hour storm. The flow of storm water from the site, within the limits of the new power block, will be designed to follow the existing flow.

Runoff from possible oil contamination areas on the north end of the site, such as the lube oil storage and transformer areas, will be contained and routed through an oil/water separator and then discharged to the ocean through existing Discharge No. 001.

Washdown from possible oil contamination areas in the maintenance area will be routed through an oil/water separator; water will then be discharged to the existing retention basin.

Erosion and Sedimentation Control.

Erosion and sedimentation control will be provided to retain sediment on site and prevent violations of water quality standards.

Permanent erosion and sedimentation control measures within the plant site will include the runoff collection system (inlets and drainage piping) and surfaced traffic and work areas. Final grading will include asphalt paving of the entire new power block area. These measures will minimize the possibility of any appreciable erosion, and the resulting sedimentation, from occurring on the site.

Temporary erosion and sediment control measures which comply with the state and local requirements will be utilized during the construction phase.

A.3.3.5 Roads

Access to the plant site will be from Vista Del Mar Road. Access within the plant site will be provided by the existing paved road system along with a new asphalt paved loop road that encircles the new power block area. The loop road will be a minimum of 20 feet wide.

The permanent parking area adjacent to the administration building will also be paved with asphalt.

The longitudinal slope of roads will not exceed 7 percent. The crown or transverse slope will be 2 percent. The minimum radius to the inside edge of roads will be 20 feet.

A.3.3.6 Fencing and Security

Chain-link security fencing topped with barbed wire will be provided around the new power block area and will tie in to the existing fencing. Fencing heights will be in accordance with

applicable codes and regulatory requirements. An existing controlled access gate is located at the entrance off Vista Del Mar Road and will be utilized for access to the new power block.

A.3.3.7 Sanitary Waste System

Sanitary wastes from the proposed and existing generating plant will be discharged via a new pipeline to the municipal sanitary sewer that is operated by the City of Manhattan Beach. Connection to this existing sanitary sewer will be on the south end of the site and will include the addition of approximately 150 feet of pipeline beyond the south property line.

The average wastewater discharge is expected to be approximately 750 gpd from the proposed and existing units.

Construction of the proposed sewer line will be expected to meet water quality requirements under Federal rules, as well as local limits established by the City of El Segundo and the City of Manhattan Beach.

The pipeline will be constructed of PVC material approximately 3 inches in diameter buried under a minimum of 24 inches of compacted soil.

A.3.3.8 Spill Protection

Spill containment measures will be provided for chemical storage tanks and chemical additive/lube oil skid areas. Aqueous ammonia is currently utilized and stored in an on-site underground 20,000 gallon tank. An aqueous ammonia pipeline will be installed from the adjacent Chevron facility refinery to the existing storage tank to meet the ammonia requirements for the new power block. Therefore, additional on-site storage of aqueous ammonia will not be required.

All other chemical storage tanks will be provided with a containment structure with a volume equal to at least 110 percent of the tank capacity. In addition, all outdoor containment structures will have a volume equal to at least the capacity of the tank plus the volume of rainfall from a 50-year, 24-hour storm.

Concrete curbs will be provided for chemical additive/lube oil skid areas. Where required for protection of the containment structure, appropriate surface coatings will be provided.

A.3.4 Geotechnical Investigation

The Geotechnical Engineering Investigation for the project is included as Appendix G.